COMPARATIVE RENTS FOR FARMLAND AND TIMBERLAND IN A SUBREGION OF THE SOUTH

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Abstract

This study compares equivalent annual rents for two alternative land uses in a region where farming and timber plantations coexist. The comparison is motivated by the possibility that rising timber prices may stimulate timber processors to compete for farmland. Prices, costs, and market rents are assumed to first follow existing trends and then to reach steady state values. Market rents are projected and capitalized for agriculture. Internal soil rents are capitalized for timber. The results show timber to have a comparative advantage on high fertility sites and suggest that timber might become a competitive land use at the intensive margin of the region's farmland base.

Key words: land rent, timber, discounting, optimal rotations, loblolly pine, investment.

A Forest Service analysis of the timber situation in the United States projects significant increases in the demand for southern pine, both because of economic growth and the South's improving competitive position relative to the Pacific Northwest. Yet, the timberland base is expected to continue to decrease and future growth on private nonindustrial lands is expected to be lower than originally anticipated (Haynes and Adams). The resulting situation is one of limited supply response to an increasing demand, with rising real prices for softwood timber products and southern pine standing timber (stumpage).

Part of the expectation about timber supply response stems from the presumption that the timberland base consists of land left over from other uses, and that acreage of timberland will not respond to timber price changes. Historical land use patterns support this presumption for private nonindustrial landowners such as farmers and rural homeowners. From 1952 to 1977, for example, real prices of southern softwood stumpage increased from an index value of 57.8 to 138.9 (1967 = 100). Despite this real price rise, private nonindustrial timberland holdings decreased from 143.7 to 134.1 million acres. In the same period, however, industrial holdings increased from 32.1 to 36.2 million acres. Thus, pulpmill, sawmill, plywood mill, and other industrial timber producers apparently responded to rising stumpage prices by increasing their acreage in timber production.

These land use patterns are consistent with the hypothesis that industrial and nonindustrial landowners assign different discount rates to the timber investment. Nonindustrial owners are likely to assign high discount factors to an investment which takes decades to complete, which pays off only at the end of the investment (or when the land is sold), and which encompasses risk of loss from disease, fire, or other natural causes. Industrial owners are likely to assign lower rates for several reasons. They are corporate entities with a planning horizon unrestricted by an individual's life span. They generally have the financial resources to hold large acreages of timberland and can alleviate part of the illiquidity of the timber investment by harvesting portions of their land on a regular basis. Most important, they can offset the risk of growing timber by the opposing risk of raw material shortages for their mills. Given substantially lower discount rates, industrial owners may find timberland to be an attractive investment at the same time nonindustrial landowners find it advantageous to disinvest.

Most of the increase in the industrial land holdings occurred before 1970. Since then, timber processors have turned more to the contracting of cutting rights for timberland and less to the purchase of farm and forest land for timber production. One possible explanation for this change is that differences in net returns from the land uses are forcing the industrial investors out of land market and into a position where they can only seek to ensure access to existing timber. This explanation assigns primary importance to market prices and costs, and implies that timber production is truly a

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residual land use. An alternative explanation is that industrial owners have increased their discount rates, perhaps in response to changes in interest rates or investment capital availability. Future land use patterns are less certain in this second case, for prospective raw material shortages, increased profits or changes in public policy can cause timber processors to revise their discount rates and to reenter the land market.

This study is concerned with the comparative role of prices and discount rates in determining relative returns to timberland, and with the comparative market returns to timberland and farmland. It presents a comparison of potential rents accruing to the two land uses in a subregion of the South. Rents are derived from the present values of streams of maximum net returns accruing to the land asset in a competitive market (Ricardo; Gaffney; Samuelson). Thus, the rent estimates will capture the effects of rising real timber prices, farmland use values and discount rates. They will not, however, reflect institutional factors such as tax differentials which would affect the land use decision. This rent comparison is a preliminary analysis, designed to determine if the market prospects for timber production are poor enough to justify the assumption that timber acreage will not respond to the expected price rise.

The comparison of rents between timberland and farmland is complicated by the absence of market rental values for timber. Methodology to estimate internal rents for timberland in the case of rising timber prices has only recently been developed (McConnell et al., Hardie et al.). This analysis is the first attempt to apply this methodology to a rural land market. The analysis is limited by the latent nature of the discount rates, by the necessity of prescribing a production plan for the timber enterprise, and by a lack of information about the relative fertilities of existing farmland and timberland. Farmland is defined in the analysis as cropland and pastureland. Timber production data are relevant to Maryland, Virginia, and part of North Carolina. The timber yield estimates used in the analysis are for loblolly pine plantations established on old fields, a common type of plantation in the study area.

The models used to estimate the rental values of the two land uses are presented in the next section. A description of empirical assumptions follows presentation of these models. Then, the results are presented and discussed in the final section.

RENT MODELS

The theoretical basis for the rent comparison traces back to Faustmann and Ricardo. This theory is developed in detail for the steady-state case in Gaffney and Samuelson. Samuelson presents the required conditions for internal and external rents to be conceptually equivalent measures of land value. Comparable rental values will be attained if:

1. the land rental market is competitive,
2. timberland rents are determined from the present value of a stream of maximum returns for a perpetual timber enterprise,
3. farmland rents are determined from a capitalization of market rents over the expected infinite life of the land asset, and
4. rent values are determined by multiplying these land values by the discount rates.

Use of the infinite horizon puts returns from the two land uses on an equivalent annual basis. The present value maximization and competitive market assumptions ensure that highest possible values are compared for both land uses. Maximization of the timber returns involves selection of a series of optimum harvest ages. This is the central problem in computing the timberland rents.

Maximum rent or present returns to timber can be easily computed when the optimum harvest age is the same for all successive timber crops (Clark). Maximum rents cannot be determined at all when prices, costs, and optimum harvest ages vary over the entire planning horizon (Heaps and Neher). The models used in this analysis incorporate the specific assumption that market rents, timber prices, and plantation costs attain steady-state values after 50 years. This assumption allows introduction of rising timber prices for the period for which estimates are available. Yet, it makes the present returns computation feasible by ensuring a common optimum age for the infinite series of timber crops harvested after the steady state is attained.

Present net returns to the agricultural land use can be expressed as:

$$(1)\ R = \sum_{t=o}^{\infty} M(t)e^{-rt},$$

where:

R = present net returns evaluated at the start of the planning horizon (1980),

t = an index of years with 1980 = 0,

M = annual per acre cash rent for the site, and

r = an instantaneous discount rate.

The rent function M is assumed to be single-valued, finite and non-negative. Because the domain of this function is an open interval, R cannot be numerically evaluated. If, however, the agricultural rent is assumed to take on the steady-state value M^o by the date t = 50, equation (1) may be rewritten as:

$$(2)\ R = \sum_{t=0}^{50} M(t)e^{-rt} + M^{o} \sum_{t=50}^{\infty} e^{-rt} = \sum_{t=0}^{50} M(t)\, e^{-rt} + (M^{o}/r)e^{-50r}.$$

Rent for the agricultural land use alternative is determined by multiplying this capitalized value by the discount rate.

Market rents are replaced in the timber land use alternative by the net return from harvesting timber, computed under the assumption that the trees are cut at the economically-optimum harvest age. For a single timber crop planted at the beginning of the planning horizon, these net returns would be:

$$(3)\ R = \underset{A}{\mathrm{Max}}\,[P(T)Y(A) - C(T)]\, e^{-rT} - C(0),$$

where:

R	=	present net returns,
A	=	age of the trees at harvest,
T	=	date of the harvest, expressed such that T = 0 in 1980,
P(T)	=	timber price in year T,
Y(A)	=	yield per acre at age A,
C(T)	=	per acre costs incurred at date T, and
C(0)	=	per acre costs of establishing the timber crop.

In equation (3), net returns from harvest are discounted to the start of the timber crop and costs of establishing the trees are subtracted. Since the starting date is adjusted to zero, T equals A and either may be substituted for the other.

The timber price and cost functions are assumed to be single-valued, finite, non-negative, and continuous. Costs are composed of plantation establishment costs and P is the price paid for standing timber (a stumpage price). Equation (3) is for the particular production plan in which timber is planted and then left to grow undisturbed until harvest. This equation would have to be modified for "intensively managed" stands which are thinned, fertilized, weeded or otherwise managed.

Yield is assumed to be a single-valued continuous increasing and concave function of the age of the trees, and to equal zero whenever A equals zero. Although the yield function is expressed in terms of a single argument in equation (3), yield will also depend on stocking density and fertility of the site. Both of these factors will be considered in the empirical function used in this study.

The timber soil rent model is obtained by extending equation (3) to an infinite series of future timber crops:

$$(4)\ R = \underset{A_i}{\mathrm{Max}}\,[\sum_{i=1}^{\infty} (P(T_i)Y(A_i) - C(T_i))e^{-rT_i}] - C(T_o), \text{ and}$$

$$(5)\ A_i = T_i - T_{i-1}; \qquad T_o = 0.$$

In equations (4) and (5), i = 1,2,..., ∞ represent the successive timber crops. Equation (5) embodies the assumption of a zero timber regeneration lag: the next timber crop is begun in the same period that the current crop is harvested. This assumption is sufficient for the harvest age to be the same as the rotation length, which is defined as the interval between successive harvest dates. Given that the price and cost functions take on steady state values (denoted by degree sign superscripts) after 50 years, the soil rent model may be written as:

$$(6)\ R = \underset{A_i}{\mathrm{Max}}\,[\sum_{i=1}^{k} (P(T_i)Y(A_i) - C\,(T_i))e^{-rT_i} + \sum_{i=k+1}^{\infty} (P^{o}Y(A_i) - C^{o})e^{-rT_i}] - C(T_o)$$

$$= \underset{A_i}{\mathrm{Max}}\,[\ \sum_{i=1}^{k}\ P(T_i)Y(A_i) - C(T_i)e^{-rT_i}] + \underset{A_o}{\mathrm{Max}}\ [(P^{o}Y(A^{o}) - C^{o})/(e^{rA^{o}}-1)]e^{-rT_k} - C(T_o).$$

Rents comparable to market rents are obtained by multiplying R by the discount rate.

Equation (6) is subject to equation (5), and to the condition:

$$(7)\ T_k \leq 50, k \geq 1.$$

Equation (7) specifies that at least one timber crop must be harvested before 2031, when the steady state price and cost values are attained. Equation (6) can be easily generalized by modifying the 50-year assumption, but is most suitable for the data available for this analysis.

EMPIRICAL ASSUMPTIONS

Models (2) and (6) require yield, price, cost and rent data for a 50-year horizon. Price forecasts are derived from the Timber Assessment Market Model (Adams and Haynes). Yield data are estimated from a yield model developed from equations estimated by forest biometricians for plantations in the study region (Hardie). Farmland rent trends are based on a 58-year historical series of annual cash rents for cropland in the State of Virginia (Economic Research Service). Timber plantation cost trends are from a 22-year unpublished series collected for pine plantations in Virginia by the U.S. Forest Service.

The data used in the rent comparison are presented in Table 1. Three data series are given for each item in the table, so the sensitivity of the results to changes in the data can be investigated. The series labeled "average" are forecast and trend values. Those labeled "high" and "low" are arbitrary adjustments of the "average" series based on subjective judgement of what would constitute a reasonable data range.

The yield data, labeled "site index 50" to "site index 70" in the table, are for three different site fertilities, which are measured by an index of the height in feet of dominant and codominant trees at age 25 (Burkhart, Burkhart et al.). These yields are dependent on a stocking relationship developed by Parker. The presented data are for the time period 1980-2030.

Since quality is an important attribute of the value of a timber harvest, yields and prices are divided in Table 1 into figures for saw-timber and pulpwood products. The tabled yield figures are for multiple products obtained in a single clearcut harvest. Possible harvest dates encompass both pulpwood and sawlog rotations so the effect of quality change can be captured. Evidence exists that net returns can be enhanced by thinning and other cultural practices which increase the quality and yield of a timber stand (Forest Service, pp. 460-528), but this possibility is not investigated. Since the tabled yield data are for unthinned and unmanaged plantations, timberland rent estimates can be viewed as conservative estimates of the value of the timberland use.

The most serious difficulty encountered in the development of the rent comparison derives from a lack of information about comparative fertilities of farmland and timberland. The only available information relating site productivities between the two land uses is the fact that some of the measured plantations are established on cropland converted during the Soil Bank program. In the absence of a better alternative, observed ranges of farmland and timberland fertilities are simply matched. This matching *does not* allow for the possibility that farmland has a higher average fertility than land in timber plantations, and *it may bias* the rent comparison against the timber production alternative as a consequence.

OPTIMUM TIMBER HARVEST AGES

Application of the rent models to the assembled data provides estimates of equivalent annual per-acre rents accruing to the farm and timberland uses. It also provides optimum (i.e., rent maximizing) harvest ages for the series of timber crops produced in the timber enterprise. Optimum ages are of interest because they indicate the period of investment during which the land would have to be committed to each timber crop. Since this period is considerably longer than that required to realize returns from farming, the timber investment would have to earn a premium to compensate for its relative illiquidity.

The formulation of the timber soil rent model mandates the same optimum harvest age for all

TABLE 1. INPUT DATA USED IN COMPARATIVE RENT ANALYSIS OF TIMBERLAND AND FARMLAND: MARYLAND, VIRGINIA AND NORTH COASTAL PLAIN OF NORTH CAROLINA, 1980-2030[a]

	Age of trees							
Item	0	20	25	30	35	40	45	50
Sawtimber prices (average)	187	303	337	371	405	441	477	514
Low	187	243	259	277	294	312	330	349
High	187	361	411	462	515	568	623	678
Pulpwood prices (average)	15	19	20	21	23	24	26	27
Low	15	17	18	18	19	20	21	21
High	15	21	23	25	27	29	31	34
Cost at harvest (average)	242	284	291	299	306	313	319	326
Low	242	252	255	257	259	262	264	266
High	242	313	326	338	350	361	372	383
Yields—site index 50								
Sawtimber	—	—	0.41	1.27	2.63	4.16	5.59	6.74
Pulpwood	—	—	20.2	25.5	28.5	29.3	29.6	32.0
Yields—site index 60								
Sawtimber	—	—	1.33	4.02	7.67	11.10	13.64	15.20
Pulpwood	—	—	26.2	29.8	30.0	28.3	31.1	34.8
Yields—site index 70								
Sawtimber	—	—	4.71	13.11	22.21	28.70	31.93	32.70
Pulpwood	—	—	28.8	24.8	18.2	17.4	22.0	29.0
Farmland rents (average)	40	51	54	57	60	63	66	69
Low	40	41	42	42	43	43	44	44
High	40	62	68	74	80	85	91	97

[a]Units of measurement are as follows: sawtimber prices = dollars per 1,000 board feet, pulpwood prices = dollars per cord, costs at harvest = dollars per acre, sawtimber yields = 1,000 board feet per acre, pulpwood yields = cords per acre, and agricultural rents = dollars per acre per year. Monetary values are in 1980 dollars.

Table 2. Optimum Age at Which to Harvest Timber: Loblolly Pine in Maryland, Virginia and North Carolina, Given "Average" Data Series

Site fertility and discount rate		First crop timber returns option: Low	Projected	High	Subsequent crops
		------------- Years	-------------		
Site index 50:					
Discount rate (%):	3	45	45	45	40
	4	40	45	45	35
	5	40	40	40	35
	6	35	35	40	35
	7	35	35	35	30
	8	30	35	35	30
	9	30	30	30	30
	10	30	30	30	30
Site index 60:					
Discount rate (%):	3	40	40	40	35
	4	35	40	40	35
	5	35	35	35	35
	6	35	35	35	30
	7	30	35	35	30
	8	30	30	30	30
	9	30	30	30	30
	10	30	30	30	30
Site index 70:					
Discount rate (%):	3	35	35	35	35
	4	35	35	35	30
	5	30	35	35	30
	6	30	30	30	30
	7	30	30	30	30
	8	30	30	30	30
	9	30	30	30	30
	10	30	30	30	25

timber crops except the first. Thus, two ages are sufficient to characterize the entire planning horizon. As Table 2 indicates, the optimum age for the first crop ranges from 30-45 years, depending on the discount rate, the fertility of the site and the projected change in harvest returns over time. Most optimum harvests fall in the 30-35-year range, with longer investment periods confined to cases of low discount rates and fertility levels. As would be expected, the optimum harvest age decreases with increases in site fertility and discount rate. It increases when harvest returns are projected to rise more rapidly through time. Less expected, however, is the finding that optimum ages are greater for the first crop than they are for the subsequent crops. Maximization conditions for the timber soil rent model indicate that the rate of change in returns can dominate the level of returns in determining the harvest age. However, this situation was not expected to be encountered in the study.

Table 2 indicates that the level of returns has a small influence on the length of investment. The same harvest age is obtained, for example, whether steady-state returns are computed from the low or the high price-cost values in the age 50 column of Table 1. (Hence the single column for subsequent crops in Table 2.) This optimum age is also obtained in all but one case when 1980 price-cost values are used. The exception

Table 3. Effect of Rising Timber Prices on Rents from Timberland: Loblolly Pine in Maryland, Virginia, and North Carolina[a]

Discount rate (%)	Site index 50: Constant prices	Site index 50: Rising prices	Site index 60: Constant prices	Site index 60: Rising prices	Site index 70: Constant prices	Site index 70: Rising prices
	------------	------------	Dollars per acre	------------	------------	
3	9	33	29	81	80	200
4	3	21	20	59	63	155
5	−2	11	12	41	48	199
6	−6	3	5	28	35	91
7	−10	−3	−1	16	24	68
8	−14	−9	−6	7	14	49
9	−17	−13	−11	−1	6	34
10	−21	−17	−16	−7	−1	20

[a]The rising prices case uses "average" data series from Table 1. 1980 plantation costs are used with 1980 timber prices in the constant prices case.

indicates that harvest ages do change with the level of returns in the steady-state case, but not enough to show up when 5-year harvest intervals are combined with the given range of prices and costs.

Since the possibility of competition between the timber and farmland uses is dependent on rising real timber prices, Table 3 is developed to isolate the effect of this determinant on the rents accruing to the timberland use. Rents in the columns labeled "constant prices" are computed by setting timber prices and plantation costs equal to 1980 values throughout the planning horizon. Rents in the other columns are based on the "average" data series of Table 1, with age 50 values used for timber crops harvested after 2030. As the comparison shows, the expected rise in stumpage prices generates a significant increase in internal land rents. This effect is largest for low discount rates and high fertility sites, but is substantial for most of the discount rate-site index combinations. Similar results were also found to hold for the "low" and "high" price alternatives of Table 1, indicating that price has an important effect on rents throughout the specified price-cost range.

FARMLAND AND TIMBERLAND RENTS

Table 4 provides the basic information obtained from the comparative rent analysis. This table gives equivalent annual per acre rents for all combinations of the timber price and cash rent projections. Real discount rates of 3 to 10 percent are utilized in the analysis, a range which includes the 4 percent real discount rate that *"approximates the observed longrun return to production assets in agriculture for the past 30 years"* (Hoffman and Gustafson, p.18). This range also includes the 4 percent cutoff rate used in recent timber investment analyses (Forest Service, pp. 497 and 506-507). Plantation cost trends are not varied independently of the price projections in this analysis.

Instead, "high" prices are always paired with "high" costs and "low" prices with "low" costs. Other price-cost combinations had relatively minor effects on the comparative rents.

The latent nature of individual discount rates and the inability to correlate land use fertilities make it difficult to compare the farmland and timberland rents. But, if one is willing to consider such a comparison of before-tax values, either of two alternative ways are possible. A given rent may be chosen and discount rates compared to see if enough difference exists to compensate for the increased risk and illiquidity of the timber investment. Or, a given discount rate may be chosen and the rents compared to see if timber production pays enough of a rent premium to justify the timber investment. Either alternative format for analysis represents the same comparison, but places it in a different context.

As an example of the first type of comparison formats, suppose a landowner chooses 80 dollars per acre as a target rate of return. If the landowner holds site index 70 timberland, the 80 dollars rent could be obtained only if the landowner's discount rate is less than 6.5 percent. If the same site is of the "best" fertility level for agricultural purposes, farming would provide the 80-dollar equivalent annual rent if the landowner's discount rate is 10 percent or less. Farming would clearly be the highest valued use in this instance, and timber would require a very substantial cost or tax subsidy to be competitive. However, if the site was only of "good" fertility for farming, an 80-dollar rent could be obtained only if the landowner's discount rate is less than 3 percent. A discount premium of at least 3.5 percent would exist for timber in this instance and, given neutral or favorable tax differentials, the landowner could consider this premium adequate compensation for the increased risk and illiquidity of the timberland use.

Given the nature of the results in Table 4, rent comparisons are more easily made if the landowner is assumed to first choose a discount rate for the farmland use alternative and then to evaluate the timber option in terms of rent premiums. Suppose, for example, that a landowner chooses the 4 percent discount rate suggested by the observed longrun return to agricultural production assets. Given a site of average fertility and average price-cost projections, a rent of 51 dollars per acre would accrue to the farmland use. Given that the same site is of site index 60 fertility, a timberland rent of 59 dollars per acre would be obtained. Thus, 8 dollars per acre would be available on a before-tax basis as compensation for the increased risk and illiquidity of the timber in-

TABLE 4. EQUIVALENT ANNUAL PER ACRE RENTS FOR FARMLAND AND TIMBERLAND GIVEN DIFFERENT SITE FERTILITIES, DISCOUNT RATES AND PROJECTED VALUES: MARYLAND, VIRGINIA, AND NORTH CAROLINA, 1980–2030

Market rent projection and discount rate	Timberland rents: site index			Farmland rents:			
	50	60	70	Pasture $20	Average $40	Good $60	Rent %80
	1980 dollars						
3 percent discount rate:							
Low	21	55	139	22	41	61	81
Trend	33	81	200	34	54	74	93
High	45	107	260	49	69	89	108
4 percent discount rate:							
Low	12	39	108	21	41	60	80
Trend	21	59	155	32	51	71	91
High	30	79	202	44	64	83	103
5 percent discount rate:							
Low	4	26	83	21	40	60	79
Trend	11	41	119	30	49	69	88
High	18	56	155	40	60	79	99
6 percent discount rate:							
Low	−1	16	63	21	40	59	79
Trend	3	28	91	28	48	67	86
High	8	39	118	37	57	76	95
7 percent discount rate:							
Low	−7	7	46	20	40	59	78
Trend	−3	16	68	27	46	65	85
High	1	25	90	35	54	73	93
8 percent discount rate:							
Low	−11	0	31	20	39	58	77
Trend	−9	7	49	26	45	64	83
High	−6	13	67	33	52	71	90
9 percent discount rate:							
Low	−15	−6	19	20	39	58	77
Trend	−13	−1	34	25	44	63	82
High	−11	5	48	31	51	70	89
10 percent discount rate:							
Low	−19	−11	9	20	39	58	77
Trend	−17	−7	20	24	43	62	81
High	−16	−3	32	30	49	68	87

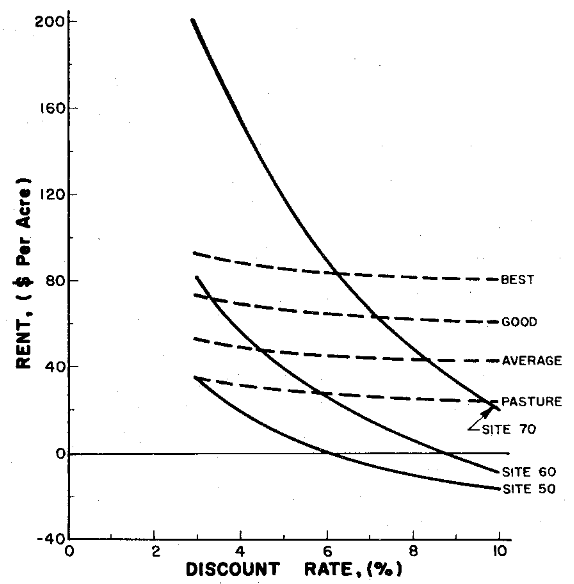

Figure 1. Comparison of Equivalent Annual Rents for Different Site Fertilities Given Forecasted Prices and Trend Rent Projections; Maryland, Virginia, and North Carolina, 1980-2030.

vestment. The landowner would have to judge if this premium is adequate to justify the timberland use option.

The basic relationships embodied in Table 4 are illustrated in figures 1-4. Figure 1 depicts comparative rents for the "average" data series and for all fertility and discount rate combinations. This figure indicates that before tax rents for the two land uses have generally similar magnitudes. Timber rents are affected much more by the level of the discount rate, however, and fall both above and below the range of farmland rents. All rents from farmland use are positive, but timberland rents fall below zero for the lower fertility sites and higher discount rates. As discount rates increase, farming becomes relatively more attractive. As they decrease, timber becomes more attractive. Farming is the highest rent alternative in all cases for discount rates above 6-8 percent.

Figure 2 represents a case in which computed rent from timber production is less than the equivalent rent from farming for virtually all discount rate, return and rent trend alternatives. This case compares site index 50 timberland to pastureland. The figure indicates that plantations on site index 50 land would earn low rates of return for real discount rates of from 3 to 6 percent, and negative returns for higher discount rates. Given these low absolute and relative rents, investment in plantations on such sites would appear to be unjustified. Given the assumption that site index 50 land can be used for pasture, timber would be the residual land use.

Site index 60 land earns a positive return unless the discount rate is 9 percent or more, Figure 3. Timberland rents for this quality of land are higher than rents from average cropland for low discount rates of 3 to 4 percent, and higher than pastureland rents for rates up to 6 percent. At 4 percent, timber would earn a premium of from -2 to 15 dollars per acre over the rent accruing to the average cropland. This small premium suggests that timber investment might be feasible for a few landowners who have low opportunity costs of investment and who have a high sense of land stewardship. But timber would not be a competitive land use for most landowners with average cropland.

Perhaps the most significant finding of the rent comparison is that timber production has a comparative advantage on the high fertility cropland in the study region, Figure 4. Rents from site index 70 timberland compare more favorably to farmland rents than rents from lower index lands at all discount rates and price-cost alternatives. This can be seen in Table 4, by comparison of site fertilities in Figure 1, and by comparison of figures 2, 3, and 4. The finding raises serious question about the conventional wisdom that timber plantations are best established on marginal fertility lands. It also suggests that if timber processors reenter the farmland market, they will be more likely to compete for the best farmland than for the worst. In short, timber's comparative advantage is at the intensive margin of the region's farmland base and not at the extensive margin.

The other significant finding is that the forecasted timber price rises are sufficient to generate some rent premiums for timber on the high fertility sites. At 4 percent, for example, timber production would earn a premium of from 28 to 99 dollars per acre over the rent

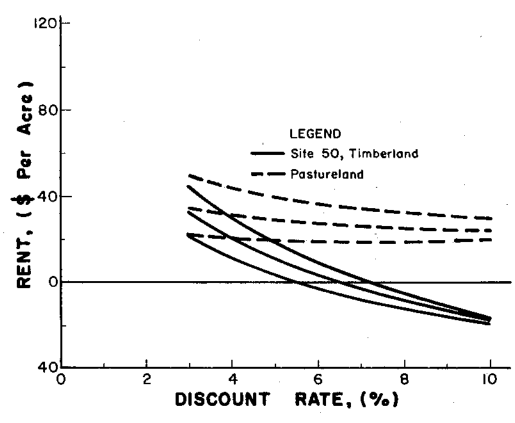

Figure 2. Comparison of Rents for Site Index 50 Timberland and Good Cropland for Three Different Price and Rent Projections; Maryland, Virginia, and North Carolina, 1980-2030.

accruing to the best cropland. This differential would increase to 48 to 119 dollars per acre if the site index 70 land is equivalent in quality to good cropland (the assumption imposed in constructing Figure 4). These rent premiums decrease rapidly with increases in the discount rate, however, and disappear when the rate rises to the 6 to 8 percent range.

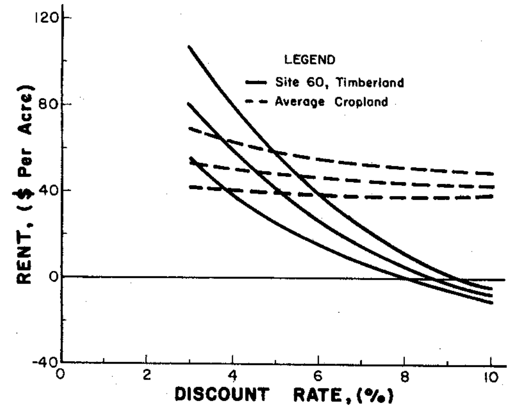

Figure 3. Comparison of Rents for Site Index 60 Timberland and Average Cropland for Three Different Price and Rent Trends; Maryland, Virginia, and North Carolina, 1980-2030.

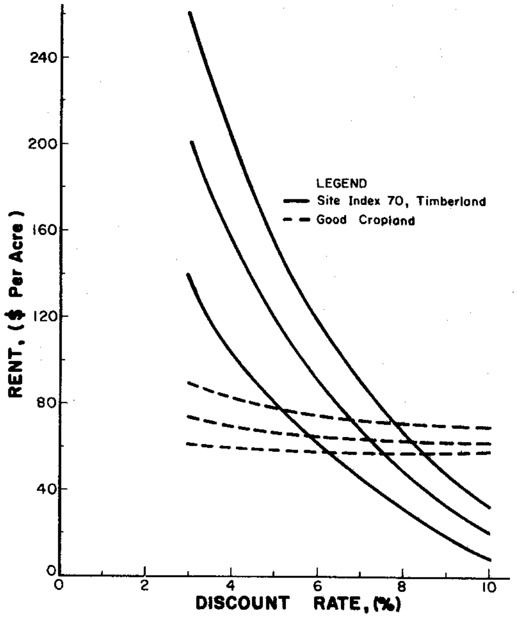

Figure 4. Comparison of Rents for Site Index 70 Timberland and Pastureland for Three Different Price and Rent Trends; Maryland, Virginia, and North Carolina, 1980-2030.

IMPLICATIONS FOR LAND USE

Since rent is only one factor in the land use decision, implications can be drawn about land use patterns only if tax differentials, alternate timber production plans, cost subsidies, and other factors are not considered. Land prices must also approximate capitalized farmland rents. Given these assumptions, the study's results are consistent with the following speculations about future land use.

The narrow range of discount rates for which timber generates rent premiums suggests that private nonindustrial landowners will be unlikely to put new land into timber. If idle farmland is also less fertile, timber investment on this land will be discouraged by the low rents accruing to the timberland use on low fertility sites. Some owners with low opportunity costs of investment, a high sense of land stewardship and access to cost sharing programs may still plant trees. But it is doubtful that the tabled net returns will be sufficient to offset the risk and illiquidity of the timber investment for most non-industrial owners. The foregoing assumes that most landowners have discount rates that exceed 6-8 percent for the timber production alternative.

Comparative timber rents on the higher fertility lands are sufficiently high for industrial owners to consider expanding timber acreage if raw material shortages appear likely. The projected risk of raw material shortages would have to lower discount rates for these owners below the 6-8 percent range. The chances of industrial owners seeking new lands would be decreased if oriented strand board, end and edge-glued lumber, and other input-conserving products cause timber prices to rise more slowly than forecasted. Chances would also be decreased if Congress decides to reject the current capital gains treatment accorded timber sales and to lower after tax returns. Despite these possibilities, market returns to timber are too high to safely assume timber processors will not buy land for timber production.

If industrial owners do reenter the land market, they will seek to buy site index 70 lands, thus competing directly with farmers for the high fertility sites. The prospect that industrial landowners will increase timber acreage decreases confidence in the residual land use assumption for timber. Unwary use of this assumption could result in a failure to recognize or anticipate significant land use changes. Comparative rents provide useful information about the possibility that rising real timber prices will stimulate competition for farmland. But they are only a starting point for analysis of an interesting and complex land use issue.

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